WHAT IS CLAIMED IS:

1. An illumination optical system for illuminating a surface, to be illuminated, with use of light from a light source, comprising:

a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane; and

an angular distribution transforming unit for transforming an angular distribution of light incident or to be incident on said diffractive optical element into a desired distribution.

2. An illumination optical system according to Claim 1, further comprising a blocking member for blocking zero-th order diffraction light produced by said diffractive optical element.

3. An illumination optical system according to Claim 1, further comprising a multiple beam producing unit and a light projecting element for superposing light rays from said multiple beam producing unit one upon another on the surface to be illuminated, wherein the predetermined plane is a light entrance surface of said multiple beam producing unit.

4. An illumination optical system according to Claim 3, further comprising a blocking member for

blocking zero-th order diffraction light produced by said diffractive optical element, wherein said blocking member is disposed at or adjacent the light entrance surface of said multiple beam producing unit, at or adjacent the light exit surface of said multiple beam producing unit, or at a position optically conjugate with the same.

5. An illumination optical system according to Claim 2, wherein said diffractive optical element is disposed at a Fourier transform plane with respect to the light entrance surface of said multiple beam producing unit.

6. An illumination optical system according to Claim 3, further comprising an optical element disposed between said diffractive optical element and said multiple beam producing unit, said optical element being movable along an optical axis direction.

7. An illumination optical system according to Claim 3, further comprising an internal reflection member effective to make uniform the light intensity distribution of the light incident on the light entrance surface thereof, wherein the light exit surface of said internal reflection member is disposed at a position optically conjugate with the light

entrance surface of said multiple beam producing unit.

8. An illumination optical system according to Claim 2, further comprising an internal reflection member effective to make, uniform, the light intensity distribution of the light incident on the light entrance surface thereof, wherein said diffractive optical element is disposed at or adjacent the light entrance surface of said internal reflection member or at a position optically conjugate with the same, and wherein said blocking member is disposed at a Fourier transform plane with respect to the light entrance surface of said internal reflection member.

9. An illumination optical system according to Claim 1, wherein said angular distribution transforming unit includes an optical element movable along an optical axis direction, wherein, with the movement of said optical element, the angular distribution of light incident on the diffractive optical element is changed.

10. An illumination optical system according to Claim 1, wherein said angular distribution transforming unit includes a plurality of optical elements demountably inserted into an optical path, wherein, with the selection of an optical element

among said plurality of optical elements, to be present on the optical path, the angular distribution of light incident on the diffractive optical element is changed.

11. An illumination optical system according to Claim 1, wherein said diffractive optical element is demountably inserted into an optical path.

12. An illumination optical system according to Claim 1, wherein said blocking member is demountably inserted into an optical path.

13. An illumination optical system for illuminating a surface, to be illuminated, with use of light from a light source, comprising:

a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane; and

a blocking member for blocking zero-th order diffraction light produced by said diffractive optical element.

14. An exposure apparatus, comprising:

an illumination optical system for illuminating a mask, to be illuminated, with use of light from a light source, said illumination optical

system including (i) a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane, and (ii) an angular distribution transforming unit for transforming an angular distribution of light incident or to be incident on said diffractive optical element into a desired distribution; and

a projection optical system for projecting a pattern of the mask, illuminated with light from said illumination optical system, onto a wafer.

15. An exposure apparatus, comprising:

an illumination optical system for illuminating a surface, to be illuminated, with use of light from a light source, said illumination optical system including (i) a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane, and (ii) a blocking member for blocking zero-th order diffraction light produced by said diffractive optical element; and

a projection optical system for projecting a pattern of the mask, illuminated with light from said illumination optical system, onto a wafer.

16. A device manufacturing method, comprising the steps of:

applying a photosensitive material to a

wafer;

illuminating a mask surface, to be illuminated, by use of light from an illumination optical system, said illumination optical system including (i) a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane, and (ii) an angular distribution transforming unit for transforming an angular distribution of light incident or to be incident on said diffractive optical element into a desired distribution;

transferring, by use of a projection optical system, a pattern of the mask onto a wafer; and

developing the transferred pattern.

17. A device manufacturing method, comprising the steps of:

applying a photosensitive material to a wafer;

illuminating a mask surface, to be illuminated, by use of light from an illumination optical system, said illumination optical system including (i) a diffractive optical element for forming a desired light intensity distribution upon a predetermined plane, and (ii) a blocking member for blocking zero-th order diffraction light produced by said diffractive optical element;

transferring, by use of a projection optical system, a pattern of the mask onto a wafer; and

developing the transferred pattern.